Pluto, the Toughest Part of the Road to ...

The toughest part of any government-funded technical-scientific endeavor is the politics and organization among people. That was the theme of the February JPL story about Pluto. The narrator was Rob Staehle, Europa Orbiter Deputy Project Manager and former manager of the Pluto Express Preproject.

Staehle was dressed casually for the informal atmosphere of the JPL stories, with an ordinary shirt and no tie. He helped set up chairs, and he greeted old friends and acquaintances as they entered the library customer service area that was serving as the auditorium.

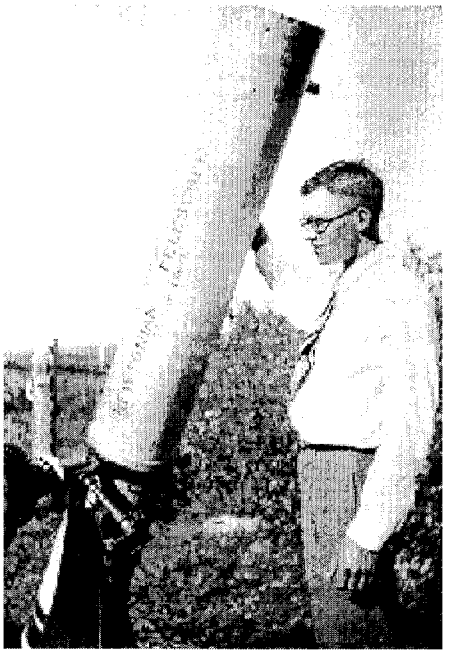
It seemed almost like a reunion, but Staehle had more serious business in mind. He noted that the people working directly on a project often do not know, or even have the time to know, all the politics and thinking that are occurring at the higher levels above them. Yet, Staehle advised somberly, it is important that the people working on a project understand that the ideas at those levels might be entirely different from those at the project level.

To illustrate his theme, Staehle told two stories linked by Pluto and by people's efforts. The first story was of Clyde Tombaugh, an earnest high school graduate and farm boy in Kansas. Tombaugh wrote to the Lowell Observatory in Flagstaff, Arizona, enclosing sketches he had made of Mars and Jupiter based on observations using his homemade 9-inch telescope and asking if they might have any advice on how to use his instrument better.

Impressed with the quality of the sketches, the Lowell Observatory offered Tombaugh a job. Three-quarters of a century before, astronomers had noted slight variations between the predicted and actual orbits of Jupiter, Saturn, and Uranus. That led to calculations suggesting an eighth planet beyond Uranus. Astronomers used those calculations to discover Neptune in 1846. However, pull from Neptune did not explain all the variation. Further calculation suggested a ninth planet, Planet X, and Percival Lowell was one of many astronomers who began looking for it. Lowell began searching in 1905, and his successors continued the quest in fits and starts after his death.

By January 1929, the Lowell Observatory had a new telescope and the new assistant, Tombaugh, to actually do the work of searching for Planet X. Tombaugh got the job not because the Lowell Observatory management wanted to make an unknown farm boy famous but because the task was hard grueling work. There was bone-chilling nightly photography with a new scope that had to be carefully maneuvered to stay in focus. During the day, when the telescope could not be used, there were mind-numbing sessions with the blink comparator, with which Tombaugh compared one night's photographs of a certain sky area with those from a week before, searching for a telltale motion against the starry background.

Every night, when conditions were favorable, Tombaugh exposed several 14-by-17-inch glass plates, each containing more than 100,000 star images that had to be compared by day. From these hundreds of thousands of images, Tombaugh worked through the balance of 1929, fighting double exposures, surges in telescope motion, and other problems. All the while, Tombaugh worried that he would have the planet's image but miss noticing it. (And indeed, later examination of plates from a search by other Lowell Observatory astronomers from 1914 to 1916 revealed two images of Planet X–once people knew where to look.) Tombaugh blinked back and forth with the comparator and then carefully repeated. Finally, in February of 1930, Tombaugh saw an object that blinked about the right amount of motion from the nights of January 21 and 30. It was Planet X.

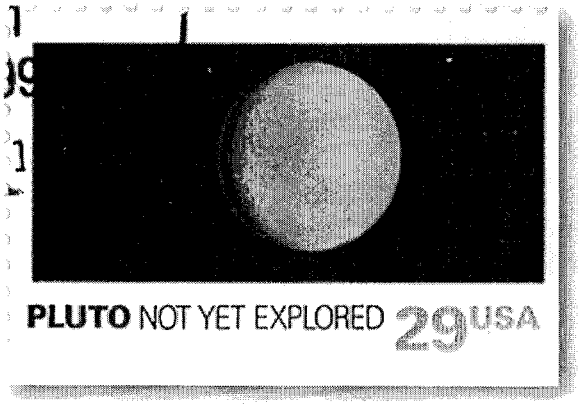


Clyde Tombaugh Before and After Quest to Find Pluto—Astronomy Can Be Brutal!*

The Lowell Observatory released the results in March 1930, and the new planet was named Pluto for the Greek god of the underworld. Mickey Mouse's dog and the new element plutonium were subsequently named in honor of the first discovery of a planet by an American. Later (in 1978), when better instruments revealed Pluto to be a double body with a large moon, the other body was named Charon ("SHAHR-on") from the boatman in Greek mythology who ferried souls to the underworld for Pluto's judgement. Memories regarding the pain of Pluto's discovery faded to the warm glow of success in the following decades.

A fast forward took Staehle's narrative to 1991, when he had just returned from working on the complexity and thankless plodding toward design of the Space Station, then years late and over budget. In his own story, Staehle could tell more of the nuances of hopes, dashed hopes, and new dreams; but he still does not have the end of the story. At the time, he wanted something new and exciting, something different from work on the Space Station.

The U.S. Post Office and Stacy Weinstein provided the something new. The Post Office unveiled a



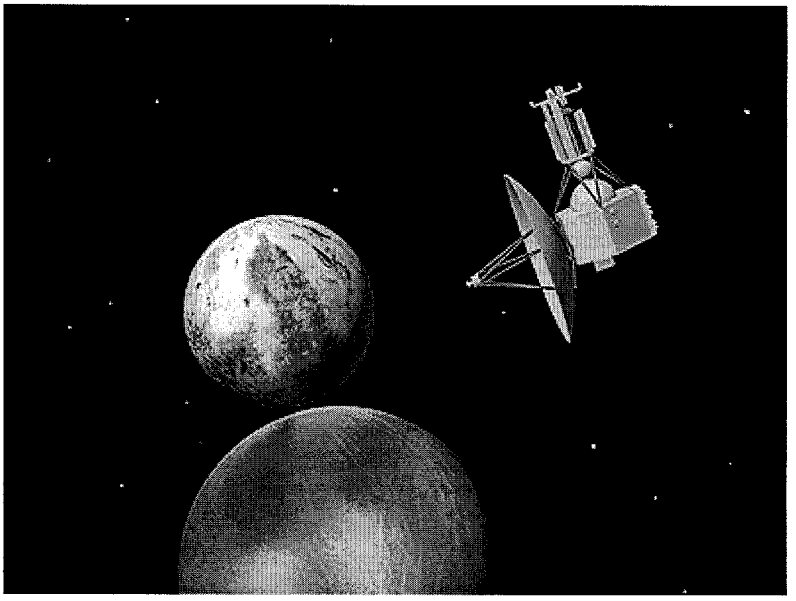
The Stamp That Showed a Crying Lack

* Oh all right, the second photograph was about sixty-five [~1928 to ~1993] years later.

series of stamps commemorating planetary exploration. The series had a stamp for missions to every planet except Pluto, where the caption simply said, "Pluto: Not yet explored." Staehle found himself looking back at the Pluto stamp and its challenge, "Not yet explored." Later that day he asked Weinstein, who was a mission designer, what she was working on. Weinstein told him she was working on a Pluto mission concept using a spacecraft and mission similar to the Cassini mission to Saturn.

Unfortunately, a Cassini-type mission to Pluto would require a great deal of money. Worse, it would require 16 to 20 years because of the large spacecraft and the vast distance to Pluto. Weinstein felt that this combination of high cost and long flight meant it would never be approved.

For all those reasons, Staehle and Weinstein changed their concept to something small and light, a 35-kilogram orbiter on a Titan launch vehicle that would arrive in 16 years, though the technology did not exist for such a small spacecraft to operate at that distance.



Early Pluto Flyby Concept (Charon in foreground)

However, having a concept was only the first step. The next step was going to JPL management to get the "proposal money," which would be used for developing more details on the concept and considering how possible problems could be overcome. Then, the design could be presented to NASA management for their consideration.

JPL Chief Scientist Moustafa Chahine was supportive but could supply no funding. Finally, Charles Elachi and John Beckman approved proposal money for basic studies.

Beckman also concurred that 16 years was too long for a mission and suggested: "Why not a flyby?" Indeed, with a flyby, Staehle and the other mission designers could also target the "Kuiper Belt" beyond Pluto. This belt, named for Gerard Kuiper who, along with several before him, theorized its existence in 1951, is a source area for comets.

So the scientific concept marketing began. Carl Pilcher, at NASA Headquarters, liked the concept, which by then was about a 100-kilogram probe needing 7 years to reach Pluto. It was something, "faster, better, cheaper," before the phrase became popular. This was an important first step.

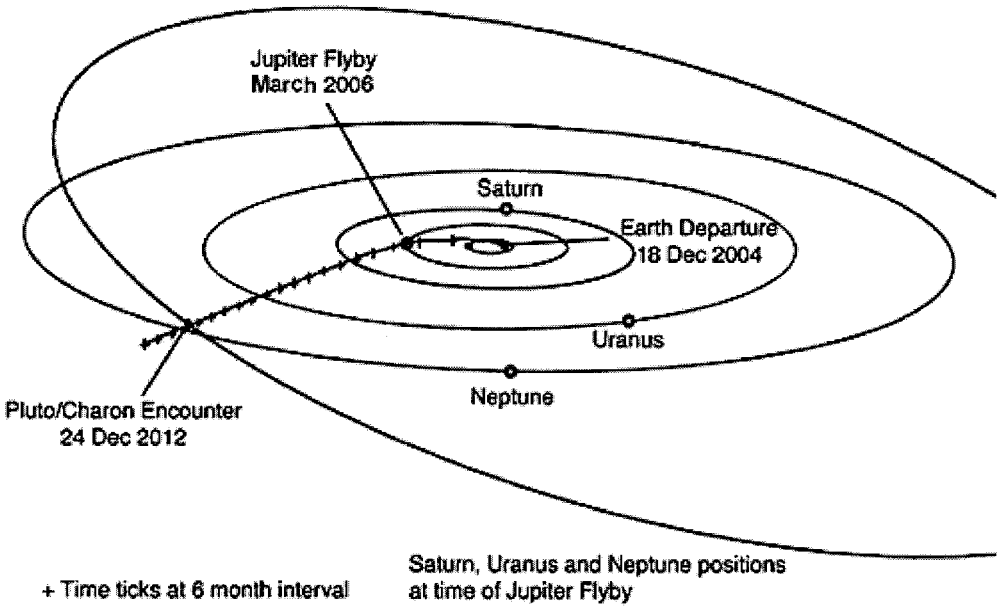
Pilcher also provided important morale support. Staehle presented the proposal to a panel of scientists called the Outer Planets Science Working Group, whose task is to consider the merits of proposed new missions. By then, the proposal was one hundred to two hundred million dollars for a camera and some radio experiments. Staehle felt that the several-hour grilling by this group had probably established that the

study group found no merit at all in the proposal. Pilcher, however, had a different view. Pilcher asked Staehle, "Were you standing up when you left the room?

Staehle replied, "Well, yes."

"Then you probably did all right," Pilcher concluded.

And Pilcher was right. He and his boss Wes Huntress (NASA Headquarters' head of Solar System Exploration at the time) were able to provide $300 thousand dollars in study money, slightly more than Staehle had requested. Those dollars helped convert an arm-waving concept into something a little closer to a real design.



Concept for an 8-year Flight--This was the Pluto-Kuiper Express baseline trajectory.

Staehle's next step was a scene straight from a Hollywood movie. Dan Goldin, the new NASA Administrator, found himself in possession of an Oscar award statue that had been virtually presented via television from astronauts aboard the Space Shuttle to producer Steven Spielberg. The statue had ended up in the NASA Administrator's office before Goldin took the job. Goldin traveled to Los Angeles for a small reception of a few dozen people to return the statue to the Motion Picture Academy of Arts & Sciences, so they could pass it on later to Spielberg. Fortuitously, Staehle was also there, having been invited by a business acquaintance who had helped organize the event.

Naturally, as NASA Administrator for about six weeks, Goldin had a chance to speak about the space program and its goals. After his remarks, Goldin suggested that anyone who was interested could come up and speak with him. Rob Staehle took the invitation, and with his section manager's approval from the day before, showed Mr. Goldin some of the JPL group's ideas for a small Pluto mission.

Goldin liked the idea and approved of what eventually became the Pluto-Kuiper Express Preproject. That was the start of the road to Pluto, but it was also the continuation of Staehle's education about the potholes and surprisingly good spots in such roads.

Following the discussion with Goldin, the designers worked feverishly to produce something that didn't require new technology. That had been an old NASA mantra for some years, and it had two major advantages for a deep space mission: it reduced risk, and it reduced cost.

However, Dan Goldin was a new administrator with new ideas. When Wes Huntress presented him some months later with the mission concept developed at JPL with the $300K study money, Goldin's question was simple. If new technology were not used on a Pluto mission, where would we use it?

The designers went back to the drawing board, and Goldin supplied nearly $10 million in 1993-94 to work on technology for the Pluto mission. The new technology work sponsored by the Pluto Preproject did develop into the Small Deep Space Transponder (SDST), power activation and switching module (PASM), beacon cruise, a new infrared spectrometer, innovative instrument breadboards, and other equipment and techniques tested and utilized on Deep Space 1 and other missions.

The next pothole was concern about radioactive materials used for power sources. Radioisotope thermoelectric generators (RTGs) had been successfully used in deep space probes for several decades, but they were politically controversial. Then, someone else had a new idea, a solar array at Pluto. The Preproject went in tight loops while the idea was examined, considered, and then rejected; a solar array at Pluto would need to be the size of a tennis court, and would likely result in a failed mission.

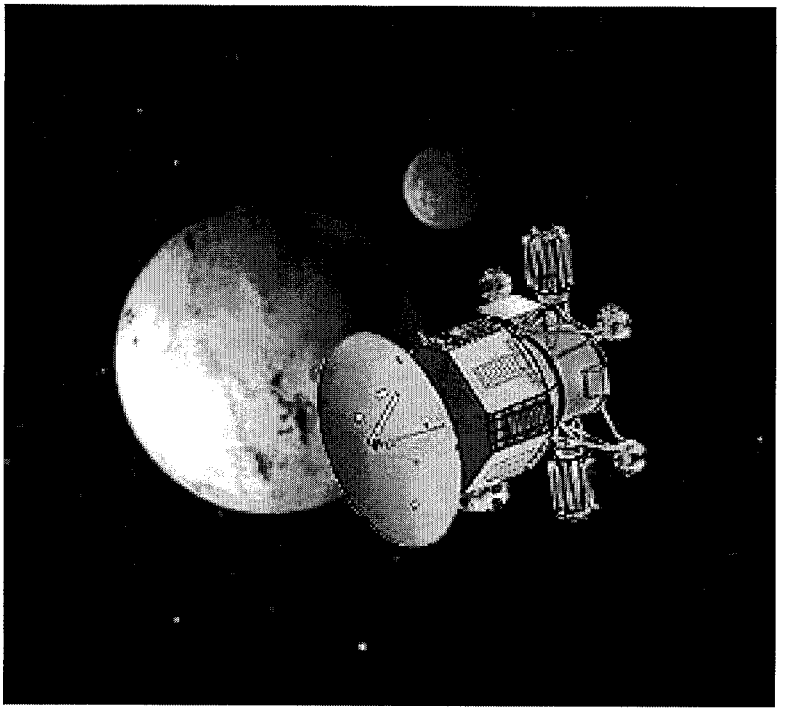
Conversely, Staehle noted that some things appeared politically bad but were actually good. On more than one occasion, certain astronomers had suggested that Pluto was not really large enough to be a planet. Hence, it should be demoted to something like asteroid. Some feared that "asteroid Pluto" might not be interesting to the public and NASA. In fact, controversy about Pluto's planet-or-not-planet status piqued public interest. Reporters filed stories, people wrote to their Congress members, and the whole thing helped keep the Pluto-Kuiper Preproject alive.

Other adventures were presented by the Russian boosters that would have offset the largest single mission cost item. Russian scientists hoped that the Russian space agency could supply two Proton launchers, very dependable rockets with a long history of successful launches. The only condition was that Russian scientists would get to have a certain number experiments. Because the Russians were providing the launchers, there would be enough money for two probes, which would reduce risk through redundancy and would provide the opportunity to get twice the data. It seemed too good to be true ... and it was. The Russian space program suffered funding reverses, and commitment for the rockets was never secured.

Meanwhile, the quick, fun, little mission was still a Preproject. Extra years began to stretch the budget. Also meanwhile, NASA had many other priorities. The Space Station needed extra development. Other deep-space missions needed funding. In September 2000, a stop-work order arrived from Headquarters.

Then, another set of viewpoints came into play. Pluto apparently has a strong attraction for not just the scientific community, but the American public as well. A surge of letters and other communications went to NASA and members of Congress on the subject. In December 2000, Headquarters decided to start again, this time with a competed activity using an Announcement of Opportunity. At the time of Staehle's talk, two teams at JPL, and others around the country, were feverishly preparing proposals for a Pluto mission having the same scientific objectives as the one on which NASA had stopped work in September—and for which funding remained precarious.

Seventy years after Tombaugh's success another quest is struggling on its way to Pluto. Every day the planet grows colder and farther away. As before, the Pluto quest is a daunting task and one that is not assured of success. The quest goes on.



Spacecraft at Pluto, Charon in Background—This is one concept for nearly identical Europa Orbiter and Pluto-Kuiper Express spacecraft to save money compared to separate designs.

Roger Carlson
5/03/01--Final